MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 3, 2015/2016

EEE 7216 – ENGINEERING OPTIMIZATION

(All Sections / Groups)

2 JUNE 2016

2.30 p.m - 5.30 p.m
(3 Hours)

INSTRUCTION TO STUDENT

1. This question paper consists of 3 pages only (including this page).

2. Attempt ALL **FOUR** questions. All questions carry equal marks (25 marks) and the distribution of the marks for each question is given.

3. Please print all your answers in the Answer Booklet provided.

Question 1

(a) Consider the system of linear equations:

$$x_1 + x_2 + 2x_3 + x_4 = 1 \quad (1)$$

$$x_1 - 2x_2 - x_4 = -2 \quad (2)$$

$x_1, x_2, x_3, x_4 = \{0, 1\}$.

(i) Rewrite the equations in matrix representation. [4 marks]
(ii) Check if the system has a solution. [5 marks]
(iii) Find the optimal solution, if the objective function is to maximize $f(x) = x_1 + x_2$, subject to constraints (1) and (2). [5 marks]

(b) As an engineer, you are required to minimize the cost of your concrete mixture that has at least 5 kg of cement, 3 kg of gravel and 4 kg of sand. The information is given below: Mixture A (30% cement, 40% gravel and 30% sand) is RM 5 per kg and Mixture B (10% cement, 20% gravel and 70% sand) is RM 1 per kg.

[11 marks]

Question 2

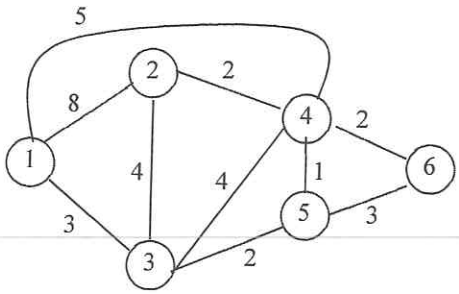

Fig. Q2a

(a) As a sales engineer, you are required to travel from point 1 to point 6, as illustrated in Fig. Q2a. Suggest a method on how you can derive to the shortest path, illustrate your work clearly.

[11 marks]

Continued...

Question 2 (Continued)

(b) A spring is stretched to length $L = 3$ cm, 4 cm, 5 cm under applied forces $F = 1$ N, 2 N, and 4 N respectively. Assuming Hooke's law $L = a + bF$ holds, where a and b are constants.

(i) Set up the system of equations to estimate $[a, b]$ using the least square linear approach. [2 marks]

(ii) Derive the pseudo inverse of this corresponding matrix. [6 marks]

(iii) Find the estimate of $[a, b]$. [6 marks]

Question 3

Consider the following integer linear programing problem:

$$\begin{aligned} &\text{Maximize} && 3x_1 + 4x_2, \\ &\text{subject to} && 7x_1 + 11x_2 \leq 88 \\ & && 3x_1 - x_2 \leq 12 \\ &\text{and} && x_1, x_2 \geq 0 \\ & && x_1, x_2 \textit{ are integers} \end{aligned}$$

(a) Solve the problem graphically. [10 marks]

(b) Use Branch and Bound method to solve the problem. [15 marks]

Continued...

Question 4

(a) Consider the following problem:

$$\text{minimize} \quad 2x_1 + 3x_2 - 4,$$

$$\text{subject to} \quad x_1 x_2 = 6$$

$$x_1, x_2 \in \mathbb{R}$$

Use Lagrange's theorem to find all possible local minimizers and maximizers. [10 marks]

(b) Given the problem to maximize

$$4x_1 + x_2^2$$

Subject to

$$x_1^2 + x_2^2 = 9$$

If the Lagrange condition for the problem is

$$4 + 2\tau x_1 = 0; 2x_2 + 2\tau x_2 = 0; x_1^2 + x_2^2 - 9 = 0;$$

Use Second Order Sufficient Condition to find the local minimizers and maximizers. [15 marks]

End of Paper.